Description

Automotive Airbag Device

Technical Field

[0001]

The present invention relates to the type of airbag device which uses a guide member, and in particularly to stabilize the flow of gas emitted from an insertion end of an inflator part into an airbag.

Prior Art

[0002]

An airbag installed on the sides of the interior of a vehicle passenger compartment, and in particularly extended from the front seat region to the rear seat region, is commonly called a "side airbag" or "curtain airbag" in the art (for example, reference document 1). When a side impact occurs, gas inflates the airbag which then expands, drops down from the passenger compartment ceiling, and covers the window, much like a curtain, in order to protect the passenger from injury. An airbag utilizing this type of structure is formed from one piece of fabric-like material folded over on itself, or two mutually overlaid fabric-like material pieces, after which the pieces of material are joined by adhering, welding, or sewing to form a bag-like structure.

[Reference Document 1] Japanese unexamined patent publication No. 2003-205811

Disclosure of the Invention

Shortcomings Resolved by the Invention

[0003]

In a conventional curtain-type automotive airbag device, inflating gas simply enters the airbag at the opening in the airbag where the insertion end of the inflator is attached, the gas flow into the airbag only being controlled by the partitions formed at the seams where the fabric-like material pieces have been joined. This operation results in the adverse effect of an unstable gas flow within the airbag in the periphery of the insertion end of the inflator, and thus indicates an

area where the design of the airbag can be improved.

[0004]

A countermeasure applied to rectify this problem has been to install a specially designed gas guide member in the airbag and to attach it to the insertion end of the inflator as means of separating or directing the gas in specific directions therethrough. It has been assumed that the gas guide member may be made from the same flexible material as the airbag in order to be able to install the airbag to the vehicle body in the form of a rolled up spiral or folded over configuration.

[0005]

It has been determined, however, that forming the gas guide member from a soft material results in the gas guide member vibrating with unstable oscillations due to the pressure of the flowing gas. This vibration has a destabilizing effect on the gas flow direction, and thus defeats the purpose of the gas guide member. Moreover, the high temperature gas may damage the airbag seams, especially those seams placed in proximity to the insertion end of the inflator. These factors have the potential to adversely affect the performance and dependability of airbag operation.

[0006]

In consideration of the aforesaid shortcoming of the conventional airbag structure, the automotive airbag device invention incorporating a gas guide member, when the gas guide member is installed within an automotive airbag in proximity to an insertion end of an inflator, achieves to stabilize the flow of gas into the airbag.

Means of Overcoming Shortcomings in the Prior Art

[0007]

The present automotive airbag device invention is primarily constructed from an airbag part formed by joining mutually facing fabric-like material pieces, and an inflator part used to inflate the airbag part by injecting gas therein, said inflator part having an insertion end part which is inserted into and disposed within the airbag part. The airbag part includes a gas guide part as means of guiding the flow of gas from the inflator part into the airbag part; a gas guide member formed as a pouch-like structure incorporating an attachment orifice into which the

insertion end part of the inflator part is inserted, and further incorporating gas injection nozzles facing the internal region of the airbag part; and a convex seam, which is formed as a mutually joined part of the fabric-like material pieces, located in opposition to the gas guide part; wherein the gas flowing into the airbag part from the inflator part, when the airbag part is being inflated, causes the gas guide member to come into contact with the convex seam.

[0008]

It is preferable that the gas guide member is equipped with a gas discharge tube part which comes into contact with the convex seam when the airbag part is being inflated. The gas discharge tube part acts to change the direction of gas flow, which is supplied by the inflator part through the gas guide part during inflation, to a transverse direction into the internal region of the airbag part. The gas injection nozzles are provided with the gas discharge tube.

[0009]

It is preferable that at least one gas injection nozzle is formed over each side of a top part of the convex seam.

[0010]

It is preferable that the part of the convex seam facing the gas guide member is formed approximately triangular in shape and the top part thereof is disposed facing the gas guide part in close proximity. It must be pointed out here that this approximate triangular shape is substantially a 3-sided shape. It is also preferable that each corner of the triangular shape is rounded off so as to form a curve through which adjacent sides of the triangle smoothly merge into each other. It is further preferable that the part of the gas discharge tube between the gas discharge nozzles come into contact with and straddle the two inclined sides of the top part of the convex seam during airbag inflation.

[0011]

It is preferable that the width of the convex seam facing the gas guide member is from 80 to 120% the width of the gas discharge tube of the gas guide member, and that the clearance between the gas guide member and convex seam is less than 20mm.

[0012]

It is further preferable that the gas guide member is made from an expandable material, and that it is designed to expand, as a result of the flow of gas therethrough, toward the convex

seam a distance at least 5mm greater than the clearance therebetween.

Effect of the Invention

[0013]

The present airbag device invention has the effect of stabilizing the flow of gas into an airbag for an airbag device of the type equipped with a gas guide member as means of directing the flow of gas from an insertion end of an inflator into the airbag.

Preferred Embodiments of the Invention

[0014]

The following provides a detailed description of a preferred embodiment of the invention with reference to the attached drawings. The present automotive airbag device invention is embodied here in the form of a side or curtain airbag comprising, as shown in Figs. 1 and 2, a pouch-shaped airbag 2 formed from fabric-like material pieces 1, and an inflator 3 which inflates the airbag 2 by injecting gas therein.

[0015]

The embodiment of the airbag 2 described in the drawings is structured from overlapping mutually joined the fabric-like material pieces 1, each piece 1 being formed to a length approximately equivalent to the combined length of the front and rear seats in the fore-aft direction, and to a height sufficient to cover the vertical dimension of the side windows. Fastening tabs 4 are located on the perimeter of the airbag 2 as means of attaching the airbag 2 to the vehicle body, and tie tabs 4a are also provided to the perimeter of the airbag 2 as means of maintaining the airbag 2 in a rolled up configuration. Moreover, a vertical passage 1a is formed as an upwardly protruding part of the airbag 2 in the center of the upper edge of each piece 1, and a horizontal passage 1b is formed as a horizontal part continuing in the horizontal direction from the vertical passage 1a.

[0016]

The fabric-like material pieces 1 are mutually joined along their edges to form loop-shaped bag seam C1 which extends from the vertical passage 1a to the tip of the horizontal passage 1b with the bag seam C1 being open at the tip of the horizontal passage 1b. In addition

to being defined by the bag seam C1, the internal region of the airbag 2 is partitioned by joining the pieces 1 of the fabric-like material at partition seams C2 which have the purpose of controlling the flow of gas from the inflator 3 into the airbag 2. The airbag 2 thus includes airbag body 2a which is internally partitioned at specific regions, inflator attachment part 2b which is defined by the horizontal passage 1b and into which the inflator 3 is inserted, and gas guide part 2c which is formed as part of the vertical passage 1a and connects the airbag body 2a with the inflator attachment part 2b as a continuation between them.

[0017]

The fabric-like material pieces 1 may be mutually joined by publicly known methods such as gluing, welding, suturing etc. Fig. 1 provides a view of either one of the pieces 1 constructing the airbag 2 before being overlapped and joined with the other piece 1. Moreover, the airbag 2 may be formed not only by overlapping and joining the two fabric-like material pieces 1, but by folding a single fabric-like piece over upon itself and joining parts of the two contacting surfaces, or by forming the bag structure at the time at which the fabric-like material is fabricated or woven.

[0018]

One end of the cylindrically shaped inflator 3 is formed as an insertion end 3a, which includes gas discharge ports 5, which is inserted into the inflator attachment part 2b. The other end is formed as a connector part 3b to which an inflator actuation wiring is connected and which is exposed externally to the inflator attachment part 2b. Fig. 2 illustrates the airbag 2 in a rolled up configuration with the inflator 3 attached, and shows the inflator attachment part 2b protruding from the rolled up airbag body 2a.

[0019]

A gas guide member 6 extends from the inflator attachment part 2b, through at least the gas guide part 2c, into the pouch–shaped airbag body 2a. The gas guide member 6, which is an expandable pouch-like structure constructed from a fabric material, includes a cylindrical trunk part 6a disposed within the gas guide part 2c, a cylindrical receiver part 6b formed along the inflator attachment part 2b at the top of the cylindrical trunk part 6a, and a cylindrical gas discharge tube 6c formed as a bi-directional horizontally extending tube-like structure at the lower end of the cylindrical trunk part 6a above the partition seam C2 within the airbag body 2a.

The gas guide member 6 is constructed from an expandable material such as a nylon 6.6 700 dtex silicone coated fabric.

[0020]

An attachment orifice 7 is formed at the end of the cylindrical receiver part 6b. The insertion end 3a of the inflator 3, which inserts into the inflator attachment part 2b, installs into the cylindrical receiver part 6b of the gas guide member 6 through the attachment orifice 7, thereby securing the gas discharge ports 5 towards the cylindrical trunk part 6a. Gas injection nozzles 8, which comprise the left and right parts of the ends of the cylindrical gas discharge tube 6c within the internal region of the airbag body 2a, are transversely disposed on a plane opposing the direction of incoming gas, and direct gas from the inflator 3 into the airbag body 2a. In this embodiment, the left and right ends of the gas discharge tube 6c form the horizontally oriented the gas injection nozzles 8. In this embodiment, a convex seam C3 is formed within the airbag 2 and disposed in opposition to the gas guide part 2c. The convex seam C3 is formed as a joint of mutually bonded portions of the fabric-like material pieces 1, and has a protruding rounded top part disposed opposite the gas guide part 2c. During inflation, the inflow of gas from the inflator 3 causes the gas guide member 6 to come into contact with the convex seam C3. More specifically, the gas inflow pressure from the inflator 3 causes the gas guide member 6, which is made of an expandable material, to expand as a result of the cylindrical trunk part 6a extending in upward and downward directions, thus resulting in the gas guide member 6 coming into contact with the convex seam C3. The convex seam C3 is formed with the same joining method used to create the partition seams C2. As shown in the drawing, the convex seam C3 is formed as the integral upper portion of the partition seam C2 disposed in proximity to the gas guide member 6. To describe further, the convex seam C3 is approximately triangular in shape with its upward facing corner part formed as a top part "T" which has a smoothly curved profile disposed in closest proximity in the transverse center of the gas discharge tube 6c of the gas guide member 6. During inflation, the part of the cylinder-shaped gas discharge tube 6c between the two gas injection nozzles 8 comes into contact with and straddles two inclined sides "S" of the top part "T". In other words, the two gas injection nozzles 8 are formed so as to move into contact with the convex seam C3 with a type of pinching action.

In order to smoothen the flow of gas entering the airbag 2, it is preferable that the other two corner parts of the triangular shaped seam C3 be smoothed out into curved profiles in the same manner as that of the top part "T".

Fig. 3 provides a detailed illustration of the dimensional relationship between the gas discharge tube 6c of the gas guide member 6 and the convex seam C3. Firstly, it is preferable that a dimension W1, that is, the width of the convex seam C3 facing the gas discharge tube 6c, be from 80 to 120% the width of a dimension W0 which is the width of the gas discharge tube 6c facing the convex seam C3. Should the width of the convex seam C3 be made to a dimension exceeding 120% of the width of the gas discharge tube 6c, there is a possibility that the gas exiting from the gas injection nozzles 8 will come into direct contact with and thermally damage the convex seam C3. Conversely, should the width of the convex seam C3 be made to a dimension less than 80% of the width of the gas discharge tube 6c, there is a possibility that the gas discharge tube 6c, although in contact with the convex seam C3, will oscillate in an unstable manner, thus resulting in the gas potentially contacting and thermally damaging seams C1 and C2.

[0021]

Moreover, it is preferable that dimension "D", which is the clearance between the gas discharge tube 6c of the gas guide member 6 and the convex seam C3 (particularly the top part "T"), be less than 20mm. The gas guide member 6, which is made from an expandable material, expands approximately 25mm along the vertical plane when directing the gas flow from the inflator 3. Considering this extent of expansion, it has been determined that a clearance of less than 20mm provides complete contact of the gas discharge tube 6c against the convex seam C3. If clearance "D" exceeds 20mm, there will be insufficient contact of the gas discharge tube 6c against the convex seam C3, thus causing the gas discharge tube 6c to flutter uncontrollably. While it has been determined that dimension "D" should be less than 20mm to assure adequate contact between the two components, experimental results have shown that a dimension of from 5 to 8mm is preferred, and that a dimension of 5.3mm provides the most stable and dependable contact between the gas discharge tube 6c and the convex seam C3.

[0022]

Moreover, considering the material characteristics of the gas guide member 6, it is

preferable that the gas flow-through pressure be able to expand the gas guide member 6 toward the convex seam C3 to an extent at least 5mm greater than dimension "D". This value is obtained by subtracting the 20mm clearance dimension from the previously noted 25mm of extension of the gas guide member 6, and is done for the same reason as stated previously.

[0023]

The automotive airbag device invention described in this embodiment is assembled by placing the gas guide member 6 within the vertical passage 1a and horizontal passage 1b on one of the two fabric-like material pieces 1. The previously noted clearance "D" is thus formed between the gas guide member 6 and convex seam C3 as shown in Fig. 1. Next, the other fabric-like material piece 1 is placed over the fabric-like material piece 1 onto which the gas guide member 6 was placed, and both pieces are joined to form the airbag 2. The insertion end 3a of the inflator 3 is then inserted into the inflator attachment part 2b of airbag 2, and enters the cylindrical receiver part 6b of the gas guide member 6 via the attachment orifice 7. The airbag body 2a is then rolled up into the configuration shown in Fig. 2, and is thus ready for installation to the vehicle.

[0024]

The following will describe operation of the airbag as structured according to the current embodiment. Once the inflator 3 activates, the gas emitted from the gas discharge ports 5 flows through and thereby pressurizes the internal region of the gas guide member 6. The pressure of the flowing gas expands the gas guide member 6, the gas simultaneously flows into the airbag body 2a through the gas injection nozzles 8, and is directed within the airbag body 2a via the partition seams C2.

[0025]

As shown in Fig. 4, the flow of gas from the inflator 3 flows through and expands the gas guide member 6, the cylindrical trunk part 6a elongates toward the convex seam C3, and the gas discharge tube 6c moves downward and contacts the top part of the convex seam C3, thereby eliminating the clearance formerly existing there between. By having the gas discharge tube 6c contact the convex seam C3, the uncontrolled oscillation of the gas discharge tube 6c is suppressed and the outflow of gas therefrom stabilized, thus eliminating the problem of gas from the gas injection nozzles 8 striking and thermally damaging the partition seams C2.

Brief Description of the Drawings

[0026]

Fig. 1 is plan view of the preferred embodiment of the automotive airbag invention illustrating the airbag in a deployed condition with one of the two fabric pieces removed for clarity.

Fig. 2 is a perspective view of the Fig. 1 airbag in a rolled up condition.

Fig. 3 is a line drawing describing the positional relationship between the gas guide member and the convex seam.

Fig. 4 is an enlarged cross section of the operating part of the airbag during deployment.

Explanation of the numerals

[0027]

1: fabric-like material piece

2: airbag

3: inflator

3a: insertion end

6: gas guide member

7: attachment orifice

8: gas injection nozzle

C1, C2: seams

C3: convex seam

D: clearance between gas guide member and convex seam

S: inclined side

T: top part

W0: width dimension of gas guide member facing convex seam

W1: width dimension of convex seam facing gas guide member